# FGHL50T65SQ

# IGBT for PFC Applications 650 V, 50 A, TO-247-3L

### Features

- Maximum Junction Temperature: $T_J$ = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ =1.6 V (Typ.) @ $I_C$ = 50 A
- 100% of the Parts Tested for ILM (Note 1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

### Typical Applications

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC

**MAXIMUM RATINGS** ($T_C$ = 25°C unless otherwise noted)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector−to−Emitter Voltage | | $V_{CES}$ | 650 | V |
| Gate−to−Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Transient Gate−to−Emitter Voltage | | $V_{GES}$ | ±30 | V |
| Collector Current | $T_C$ = 25°C | $I_C$ | 100 | A |
| | $T_C$ = 100°C | | 50 | |
| Pulsed Collector Current (Note 2) | $T_C$ = 25°C | $I_{CM}$ | 200 | A |
| Maximum Power Dissipation | $T_C$ = 25°C | $P_D$ | 268 | W |
| | $T_C$ = 100°C | | 134 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Maximum Lead Temperature for Soldering Purposes (1/8″ from case for 5 s) | | $T_L$ | 260 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $I_C$ = 200 A, Inductive Load
2. Repetitive rating: Pulse width limited by max. Junction temperature
3. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted

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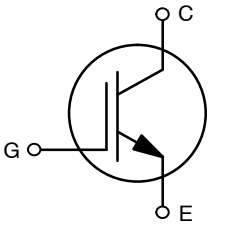
| $BV_{CES}$ | $V_{CE(sat)}$ TYP | $I_C$ MAX |
|---|---|---|
| 650 V | 1.6 V | 200 A |




**TO−247 LONG LEADS**
**CASE 340CX**

### MARKING DIAGRAM


| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = 3−Digit Date Code |
| &K | = 2−Digit Lot Traceability Code |
| FGHL50T65SQ | = Specific Device Code |

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| FGHL50T65SQ | TO−247−3L | 30 Units / Rail |

**Table 1. THERMAL RESISTANCE RATINGS**

| Parameter | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Case − Steady State | $R_{\theta JC}$ | 0.56 | °C/W |
| Junction−to−Ambient − Steady State (Note 4) | $R_{\theta JA}$ | 40 | |

4. Repetitive rating: Pulse width limited by max. Junction temperature

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise stated)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector to Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 1 mA | 650 | | | V |
| Temperature Coefficient of Breakdown Voltage | $\Delta V_{CES}/\Delta T_J$ | $V_{GE}$ = 0 V, $I_C$ = 1 mA | | 0.6 | | V/°C |
| Collector Cut−Off Current | $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | | | 250 | μA |
| G−E Leakage Current | $I_{GES}$ | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | | | ±400 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 50 mA | 2.6 | 4.5 | 6.4 | V |
| Collector to Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$ = 50 A, $V_{GE}$ = 15 V $T_C$ = 25°C | | 1.6 | 2.1 | V |
| | | $I_C$ = 50 A, $V_{GE}$ = 15 V $T_C$ = 175°C | | 1.92 | | V |
| **DYNAMIC CHARACTERISTIC** | | | | | | |
| Input Capacitance | Cies | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | | 3209 | | pF |
| Output Capacitance | Coes | | | 42 | | |
| Reverse Transfer Capacitance | Cres | | | 12 | | |
| **SWITCHING CHARACTERISTIC** | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 25 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C<br>FWD: FGH50T65SQD | | 19 | | ns |
| Rise Time | $t_r$ | | | 13 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 93 | | ns |
| Fall Time | $t_f$ | | | 6.4 | | ns |
| Turn−On Switching Loss | $E_{on}$ | | | 410 | | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 88 | | μJ |
| Total Switching Loss | $E_{ts}$ | | | 498 | | μJ |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 25 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 175°C<br>FWD: FGH50T65SQD | | 18 | | ns |
| Rise Time | $t_r$ | | | 15 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 102 | | ns |
| Fall Time | $t_f$ | | | 8 | | ns |
| Turn−On Switching Loss | $E_{on}$ | | | 641 | | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 203 | | μJ |
| Total Switching Loss | $E_{ts}$ | | | 844 | | μJ |
| Total Gate Charge | $Q_g$ | $V_{CE}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V | | 99 | | nC |
| Gate−to−Emitter Charge | $Q_{ge}$ | | | 17 | | nC |
| Gate−to−Collector Charge | $Q_{gc}$ | | | 23 | | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## TYPICAL CHARACTERISTICS

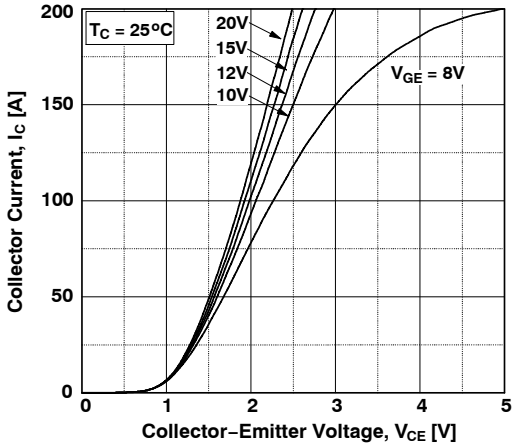



Figure 1. Typical Output Characteristics

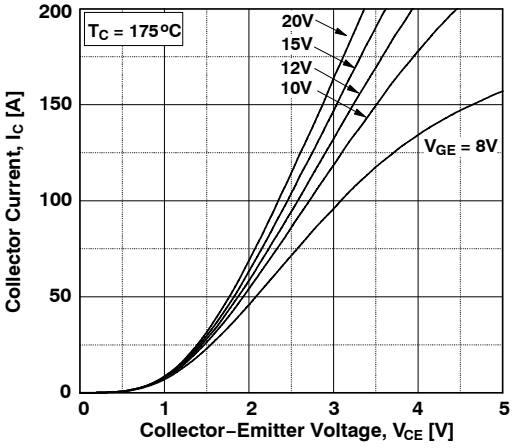



Figure 2. Typical Output Characteristics

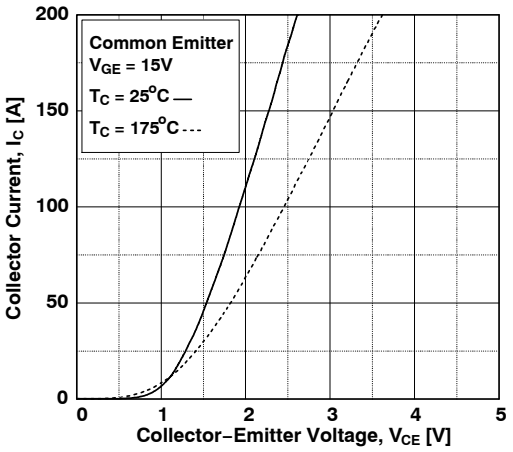



Figure 3. Typical Saturation Voltage Characteristics

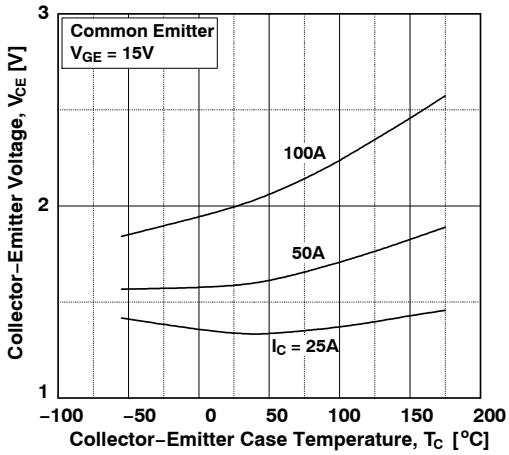



Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

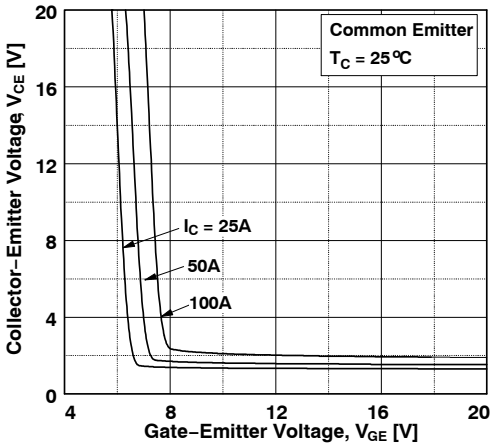



Figure 5. Saturation Voltage vs. $V_{GE}$

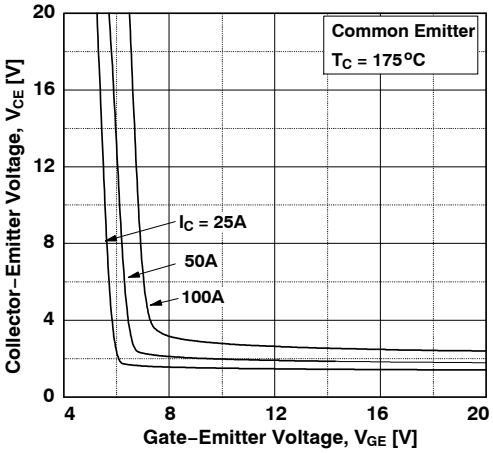



Figure 6. Saturation Voltage vs. $V_{GE}$

## TYPICAL CHARACTERISTICS

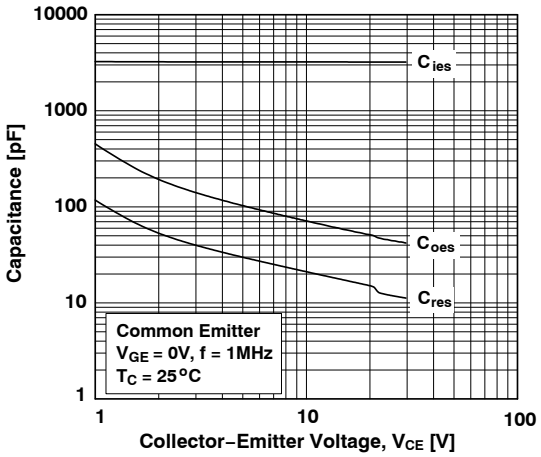



Figure 7. Capacitance Characteristics

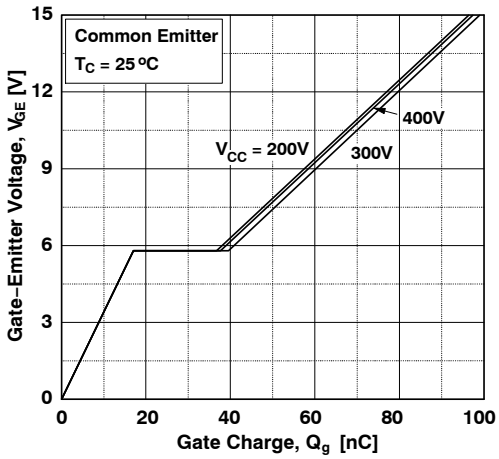



Figure 8. Gate Charge Characteristics

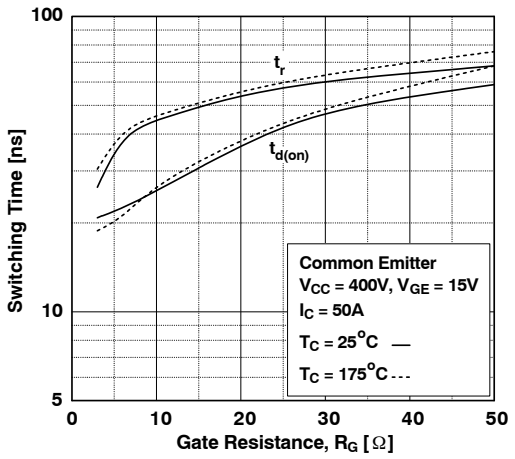



Figure 9. Turn−on Characteristics vs. Gate Resistance

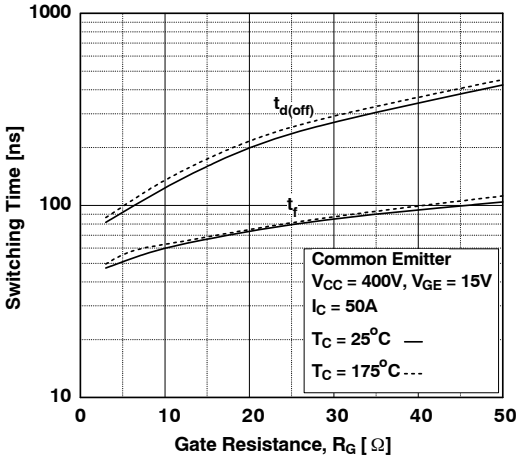



Figure 10. Turn−off Characteristics vs. Gate Resistance

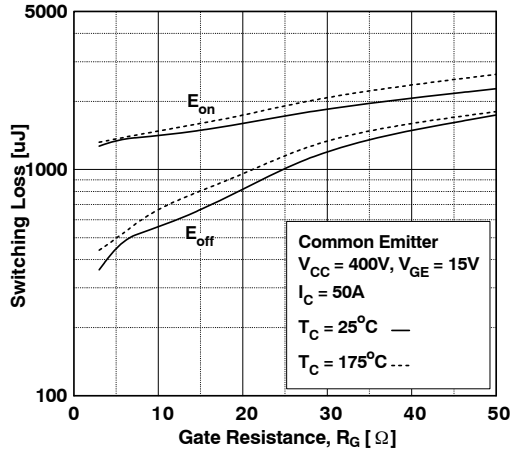



Figure 11. Switching Loss vs. Gate Resistance

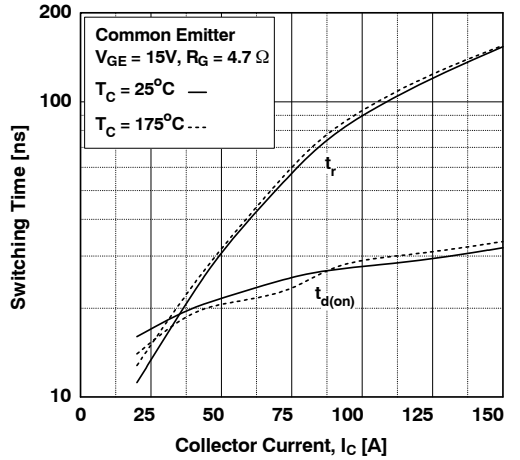



Figure 12. Turn−on Characteristics vs. Collector Current

## TYPICAL CHARACTERISTICS

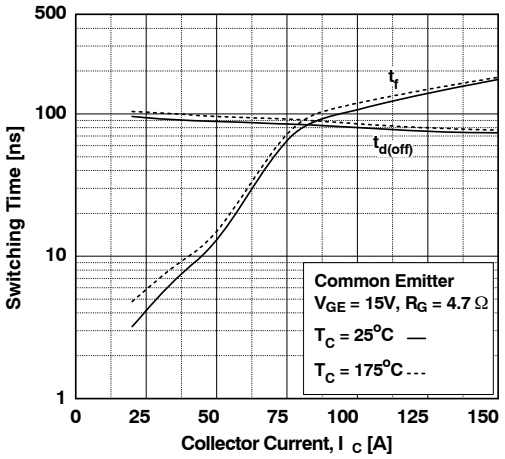



**Figure 13. Turn−off Characteristics vs. Collector Current**

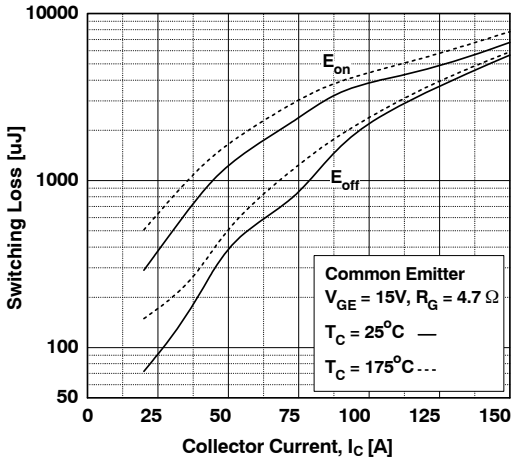



**Figure 14. Switching Loss vs. Collector Current**

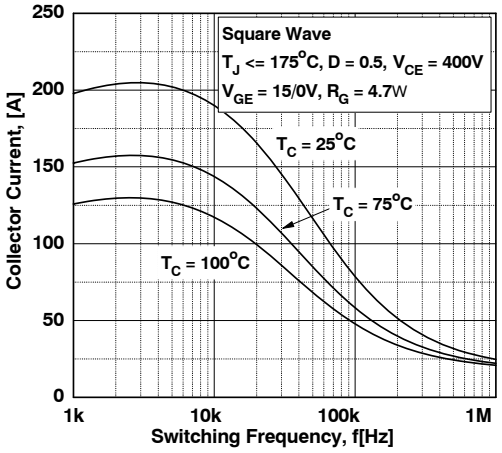



**Figure 15. Load Current vs. Frequency**

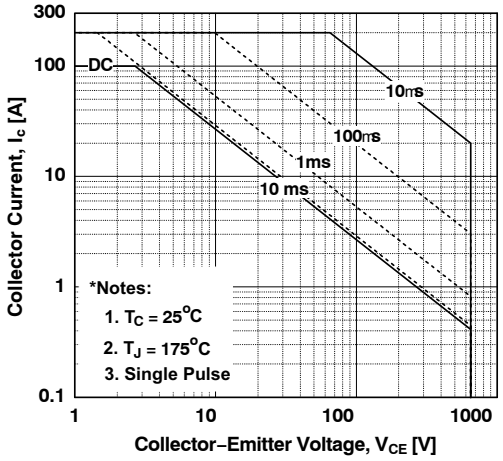



**Figure 16. SOA Characteristics**

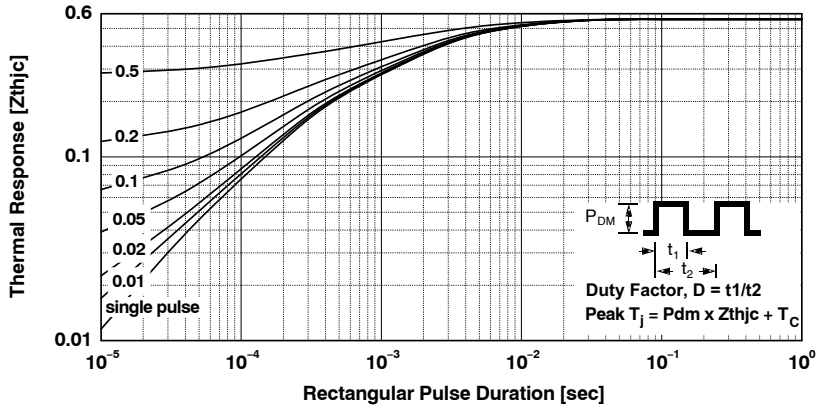


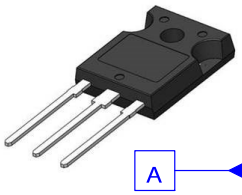

**Figure 17. Transient Thermal Impedance of IGBT**

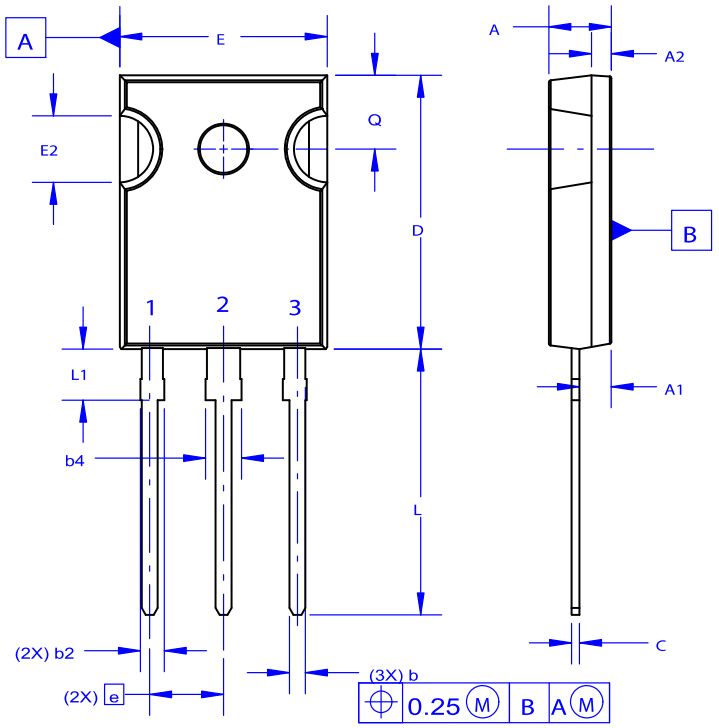
# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

ON Semiconductor®

**TO−247−3LD**
CASE 340CX
ISSUE A

DATE 06 JUL 2020






NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.20 | 2.40 | 2.60 |
| A2 | 1.40 | 1.50 | 1.60 |
| D | 20.32 | 20.57 | 20.82 |
| E | 15.37 | 15.62 | 15.87 |
| E2 | 4.96 | 5.08 | 5.20 |
| e | ~ | 5.56 | ~ |
| L | 19.75 | 20.00 | 20.25 |
| L1 | 3.69 | 3.81 | 3.93 |
| ØP | 3.51 | 3.58 | 3.65 |
| Q | 5.34 | 5.46 | 5.58 |
| S | 5.34 | 5.46 | 5.58 |
| b | 1.17 | 1.26 | 1.35 |
| b2 | 1.53 | 1.65 | 1.77 |
| b4 | 2.42 | 2.54 | 2.66 |
| c | 0.51 | 0.61 | 0.71 |
| D1 | 13.08 | ~ | ~ |
| D2 | 0.51 | 0.93 | 1.35 |
| E1 | 12.81 | ~ | ~ |
| ØP1 | 6.60 | 6.80 | 7.00 |

### GENERIC MARKING DIAGRAM*


XXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot " ▪", may or may not be present. Some products may not follow the Generic Marking.

| | | |
|---|---|---|
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| **DESCRIPTION:** | **TO−247−3LD** | **PAGE 1 OF 1** |

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